National Aeronautics and
Space Administration

Copolymer Gel Electrolyte

Advanced Copolymer Gel Electrolyte Enhances Lithium-Ion Batteries

ADVANCED ENERGY

OVERVIEW

The NASA electrolyte is a polyimide-polyethylene oxide (PEO) rod-coil copolymer gel with a highly cross-linked three-dimensional structure. Cured at room temperature, the gel can hold over four times its weight in liquid additives, accommodating both conventional carbonate solvents and room-temperature ionic liquids. The technology enables a safer, highly flexible, and environmentally friendly fabrication method for producing batteries with high ionic conductivity, high cycling stability, mechanical strength, and potentially increased cycle life.

BENEFITS

- Flexible processing
- Simplified fabrication
- Increased operating temperature range from subambient to high temperatures
- Improved safety more environmentally friendly
- Improved conduction and battery life
- Improved dimension stability and mechanical strength
- Low electrode interfacial resistance

APPLICATIONS

This electrolyte technology would enhance the performance of rechargeable lithium-ion polymer gel batteries in applications such as

- Wafer-thin geometries such as batteries for “smart cards”
- Portable electronics such as cell phones, personal digital assistants (PDAs), laptops, digital music devices, and wireless controllers
- Battery-powered robots
- Lightweight radio-controlled cars and aircraft
- Grid power storage (e.g., storing solar power during the day for use at night)
- Portable tools
- Automobile batteries

TECHNOLOGY DETAILS

This technology consists of a composite material with the cross-linked structure of the copolymer, which creates nanoscale voids. The void space is filled with a liquid, and when ionic liquids are incorporated, an increase in ionic conductivity of two orders of magnitude can be achieved. Diamine and dianhydride are reacted and cured in solution to produce an amine end-capped oligomer. The reaction with a trifunctional molecule yields a fully three-dimensional, cross-linked polymer web. The rod-coil copolymer is believed to exhibit a higher liquid uptake than any other material known in a lithium-ion battery.

PATENTS

U.S. Patent 7,704,622 New Ion Conduction Organic/Inorganic Hybrid Polymers
LEW-17592-1

WHY IT IS BETTER

An advanced battery made with NASA's gel electrolyte will have enhanced performance and be safer than any existing batteries, because there are no volatile or flammable components. The copolymer has a large capacity, holding more than four times its weight in liquid. Its high ionic conductivity improves lithium ion conductivity over a wide temperature range (particularly at room temperature) and enhances battery usefulness. Its cross-linked rod coil structure and aluminum oxide nanoparticles provide mechanical strength with low interfacial resistance.

LICENSING AND PARTNERING OPPORTUNITIES

Glenn's Office of Technology Partnerships and Planning seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Advanced Copolymer Gel Electrolyte (LEW-17592-1) for commercial purposes.

FOR MORE INFORMATION

For more information about this and other technology licensing opportunities, please contact

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